A BREEDING EXPERIMENT WITH *MANIOLA JURTINA* L. (MEADOW BROWN BUTTERFLY) AB. *POSTMULTIFIDUS* LIPSCOMB

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M. jurtina ab. *postmultifidus* is a rare and striking aberration which tends to occur in the same colonies year after year. On the underside it is characterized by having the veins crossing the lower half of the central pale band darkened with scaling which therefore connects the darker basal and marginal areas of the wing, and splits up the central band into segments. The upperside of the aberration answers to ab. *antiaurolancea* Leeds in which the forewing fulvous is broken up cleanly into segments by brown ground colour along the veins, and so is exactly analogous to the underside. Both characters have been found to be extremely variable such that the underside may have dark scaling encroaching along one or two veins, or it may clothe the veins so heavily that the pale areas between are almost obliterated. On the upperside it varies from being almost undetectable to having all fulvous of a female example absent except a ring around the eyespot and the fulvous in the 'cell' which remains unaffected as the aberration only seems to affect the median band area. It occurs in both sexes but is much more obvious in the female.

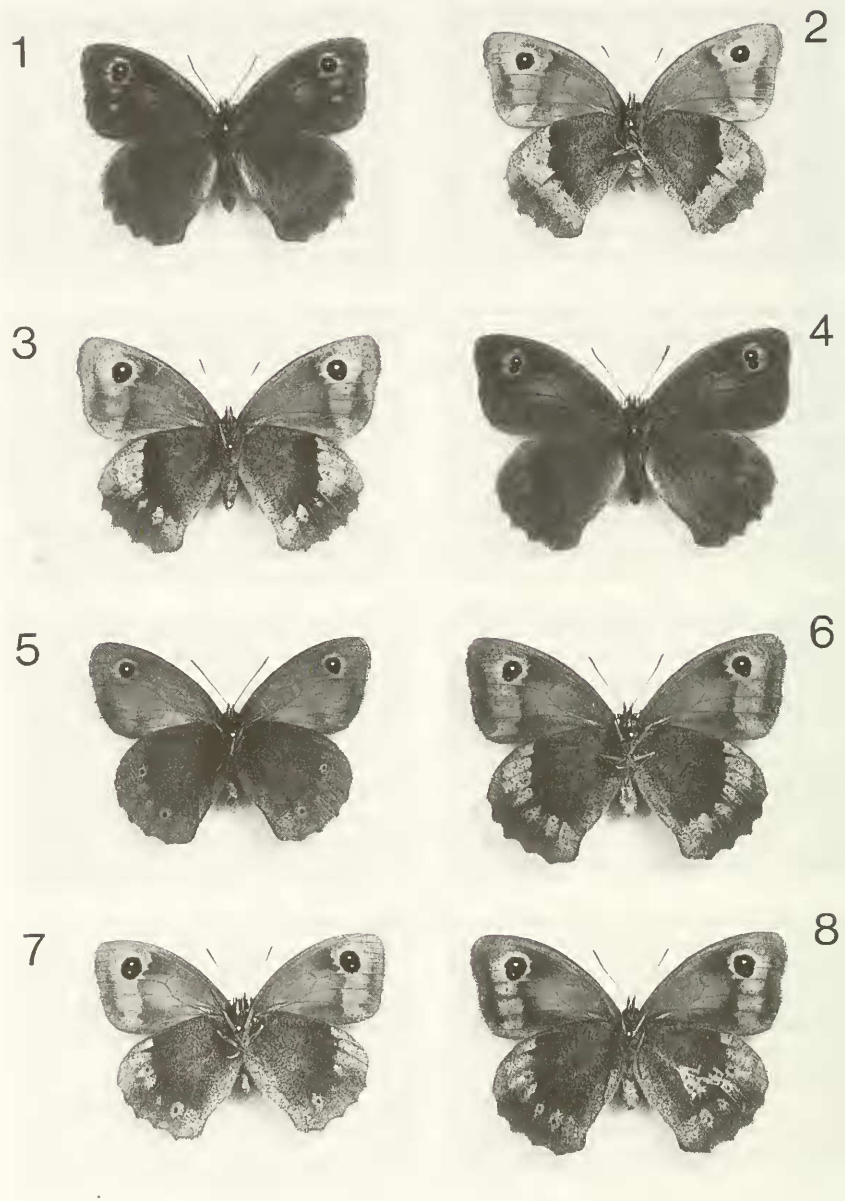
Three previous attempts to breed *postmultifidus* from wild caught examples have met with little success. I obtained an F_2 of seven insects on one occasion, and Ralph Tubbs, from ova supplied to him, one of 10 insects. In neither case were the broods large enough to draw any conclusions regarding the inheritance of this aberration.

In July 1988 a female *jurtina* was taken from a north Dorset hay meadow (where 21 examples of *postmultifidus* have been noted since 1981) showing good development of *antiaurolancea* (similar to Figure 1) and the first signs of *postmultifidus* (similar to Figure 2). About 120 ova were laid over 2 weeks, resulting in an F_1 generation of 32 insects the following June. This brood was made up of 18 aberrations and 14 types (approximately 1 : 1). The aberrant insects were so variable that at first the whole brood appeared to be a graded series from type to good aberrations; however close examination could separate them. The aberrations were mostly of lesser forms such as Figure 2, although there were several females showing virtually no upperside fulvous. Three females were fully developed *postmutifidus* (Figure 3), but it is difficult to assess how many males were as well advanced as the form is less obvious in this sex.

A number of pairings occurred between aberrations, and about 1000 ova were laid. Survival up to December was very poor and about 120 larvae remained by the spring, many quite large due to their being able to feed often in the mild winter. Fifty healthy pupae resulted, the adults consisting of 32 aberrations and 18 type (approximately 2 : 1). Again the aberrations were variable but many were well developed. Most of the females showed extreme *antiaurolancea* (Figure 4) and many of both sexes had the *postmultifidus* characteristic fully developed (Figures 5–8).

Lack of time prevented a further brood being attempted which is regrettable as extreme forms would probably have occurred.

The results suggest that *postmultifidus/antiaurolancea* is a dominant but weakening form. The 1 : 1 type to aberration ratio in the F_1 is as expected when a dominant heterozygote (the wild-caught aberration) pairs with a type example. Pairing between aberrations (all heterozygotes) in the F_1 should give a 3 : 1 aberration to type ratio in the F_2. As some of the F_2 adults showed some degree of deformity it is likely that the gene has a weakening effect leading to a reduced (in this case 2 : 1) F_2 ratio. It may be that the aberrant homozygote is completely lethal so that the F_2 generation



Figs 1–8. *Maniola jurtina*. 1: female, ab. *antiaurolancea*, F_2. 2: female, transitional to ab. *postmultifidus*, F_1. 3: female, ab. *postmultifidus*, F_1. 4: female ab. *antiaurolancea*, F_2. 5: male, ab. *postmultifidus*, F_2. 6: female, ab. *postmultifidus*, F_2. 7: female, ab. *postmultifidus*, F_2. 8: female, ab. *postmultifidus*, F_2.

contained only type and heterozygotes. Alternatively the gene may manifest a generally weakening influence in both heterozygotes and homozygotes. Only further breeding could determine which is the case.

NOTES ON BREEDING *JURTINA*

A number of entomologists, past and present, have remarked on the difficulty of breeding this species in good numbers. The present success rate of 50 adults from 1000 ova is hardly auspicious, and a previous attempt to breed this aberration resulted in no F_2 at all from over 1000 ova.

The adults pair easily in warm, sunny conditions and the females lay eggs well in sunlight or under electric light. They live for several weeks if supplied with suitable nectar flowers (creeping thistle, knapweed and catmint seem to be very good) laying 100–200 ova. Like many satyrids they show little interest in grasses in the breeding-cage, preferring to lay on the netting from where the ova are easily scraped off. The larvae suffer very badly from over-crowding, contracting highly virulent and contagious bacterial or viral infections which will rapidly sweep through a cage of larvae. The most common forms turn the first four or last few segments dark a few days before the entire larva turns black and dies. It would seem that the most successful method of breeding will result from rearing as few larvae per pot as possible. It is probably also helpful to keep the potted grass well trimmed to allow a good air-flow through the cage. In the above experiment larvae were separated when they had reached a manageable size into pots containing 25 larvae each. Spraying ova (or even larvae) with a weak formaldehyde solution has recently been suggested as a weapon against disease and may yet prove effective.

BOOK NOTICES

Fruit flies of economic significance: their identification and bionomics by I. M. White and M. Elson-Harris, 1992, Wallingford, CAB International, xii, 602 pages, paperback, £30.—Approximately 250 species of tephritids have been found in association with commercially produced fruits and vegetables. With the increasing world-wide markets for fresh horticultural produce such as tropical fruits, there is a parallel growing interest in the problems that fruit fly pests can cause. Produced in association with the Australian Centre for International Agricultural Research, this book presents biosystematic information on 250 species of economic importance as well as illustrated keys to the adults of over 100 of them.

Mealybugs of Central and South America by D. J. Williams and M. Cristina Granara de Willink, 1992, Wallingford, CAB International, vi, 636 pages, hardback, £77.50.—Although mealybugs (Hemiptera: Pseudococcidae) are normally kept to a tolerable level by natural enemies in their countries of origin, severe outbreaks can occur when species are accidentally introduced into other countries. In 1973 an undescribed South American species was accidentally introduced into Africa and severely threatened the cassava crop. It was controlled successfully by the introduction of natural enemies from South America. The book discusses 49 genera and 282 species from Central and South Americas, the West Indies and Bermuda. Comprehensive keys to the genera and species are accompanied by 281 illustrations of 269 species.
